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SOME PECULIARITIES OF THE VOLT-AMPERE CHARACTERISTICS OF THIN CADMIUM SULFIDE SINGLE CRYSTALS WITH NONOHMIC CONTACTS

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ABSTRACT

Brief discussion of the current-voltage characteristics of In electrodes; the electrodes were applied by sputtering on X and Z cuts of 100 to 200 μ CdS single crystals at room temperature or at 300°C. A well pronounced hysteresis was observed in Z-cut samples, with In contacts applied at room temperature.

The use of cadmium sulfide single crystals for ultrasound ampl- /1633* ification (ref. 1) in dielectric diodes and triodes (ref. 2), and so forth, makes it necessary to prepare ohmic contacts (ref. 3). This leads to the problem of selecting optimum conditions for obtaining ohmic contacts and their quality control. Furthermore, it is interesting in itself to determine the laws that govern the passage of current through the contacts.

*Numbers given in margin indicate pagination in original foreign text.

The present paper examines some peculiarities of the volt-ampere characteristics of nonohmic contacts on thin cadmium sulfide single crystals.

The experiments were performed with thin Z- and X-cut single crystals from 100 to 200 μ thick. Indium electrodes were deposited on both sides of the crystal surface by vaporization in a vacuum of 10^{-5} mm Hg. Two deposition methods were employed: (1) onto a crystal at room temperature and (2) onto a crystal preheated to 300°C.

The investigation of the volt-ampere characteristics of Z-cut samples with contacts of the first type revealed the presence of a clearly defined hysteresis. When the external voltage applied to a sample was increased and decreased, the values of the current strength at the same voltages differed from each other (see figure). When the external voltage was decreased to a certain value, the value of the current strength was higher than when the same value of the external voltage was reached by increasing the external voltage. With a further decrease in voltage, this relation is inversed, whereas at a certain nonzero value of the voltage the current strength became zero.

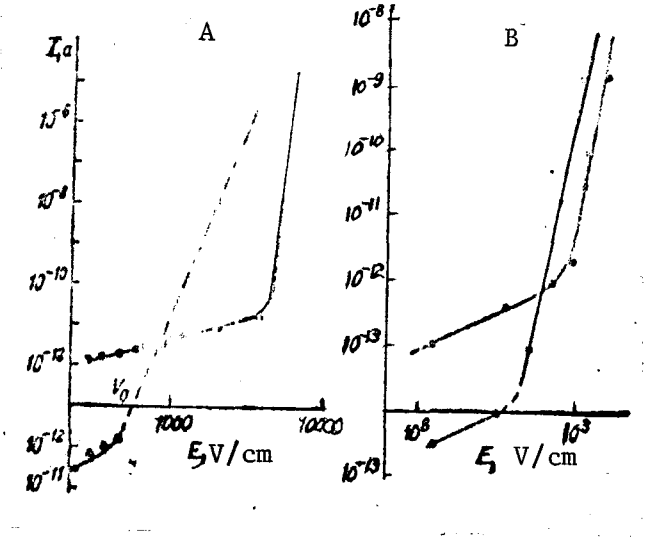

Figure. Volt-ampere characteristics of a cadmium sulfide sample with electrodes prepared by the first method. A) Z-cut, B) X-cut

This indicates that the external voltage is compensated for by the internal emf created in the In-CdS-In system under the effect of an applied electric field. When the external voltage is cut off, this emf remains in the system. In the case of a short circuit produced by a conductor, this emf acts to reverse the current flow from its direction during the formation process of the emf under the effect of the external voltage. The decrease of the /1634 emf with time is relatively slow. Illumination of the crystal substantially accelerates this process.

The investigation shows that the residual voltage created depends on the magnitude of the applied external voltage and on the period during which this voltage is applied. In the investigation of the volt-ampere characteristics of cadmium sulfide X-cut single crystals with indium electrodes prepared by the first method, it was found that residual voltage also forms in this case; however, the magnitude of the inverse current inducted by this voltage is lower by one order of magnitude (see figure, B).

The different behavior of contacts deposited on the surface of X- and Z-cuts is apparently associated with the difference in the crystallographic and chemical structure of the respective surfaces.

The volt-ampere characteristics obtained in our investigation depend on the conditions under which the samples were prepared.

It was found that the volt-ampere characteristic of an X-cut sample having contacts prepared by the second method experiences only slight hysteresis. For a Z-cut, in the same case, the hysteresis is pronounced, although it manifests itself less strongly than when the contacts on the Z-cut are produced by the first method.

It was established that the presence of hysteresis is associated with the "nonohmicity" of a contact. The degree of nonohmicity was estimated from the inertial properties of the system. It appeared that the time required to obtain a steady current after application of an external voltage depends mainly on the nature of the volt-ampere characteristics of the samples. The time required for current stabilization grows in proportion to the magnitude of the hysteresis.

For an X-cut sample with contacts prepared by the second method, the inertial properties are insignificant. In all other cases studied, the samples possess pronounced inertia.

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